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Bennie et al.

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(54) **EMERGENCY VEHICLE MANEUVER COMMUNICATIONS**

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(71) Applicant: **Ford Global Technologies, LLC**,
Dearborn, MI (US)

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(72) Inventors: **Brian Bennie**, Sterling Heights, MI (US); **Brad Alan Ignaczak**, Canton, MI (US); **Randy Michael Freiburger**, Novi, MI (US); **Thomas Lee Miller**, Ann Arbor, MI (US)

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(73) Assignee: **Ford Global Technologies, LLC**,
Dearborn, MI (US)

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Primary Examiner — Mussa A Shaawat

Assistant Examiner — Yazan Soofi

(74) *Attorney, Agent, or Firm* — Frank MacKenzie; Bejin Bieneman PLC

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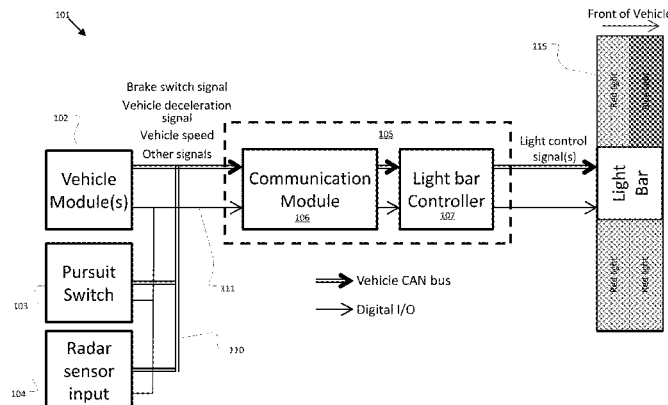
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(57) **ABSTRACT**

Improved vehicle emergency lighting control may be implemented in a vehicle computer. Data may be collected related to a pursuit of a second vehicle. The collected data can be used to determine at least one of an action of the first vehicle and an action of the second vehicle. An emergency light in the first vehicle can be controlled based on the at least one determined action.

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20 Claims, 5 Drawing Sheets



- (51) **Int. Cl.**
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- (52) **U.S. Cl.**
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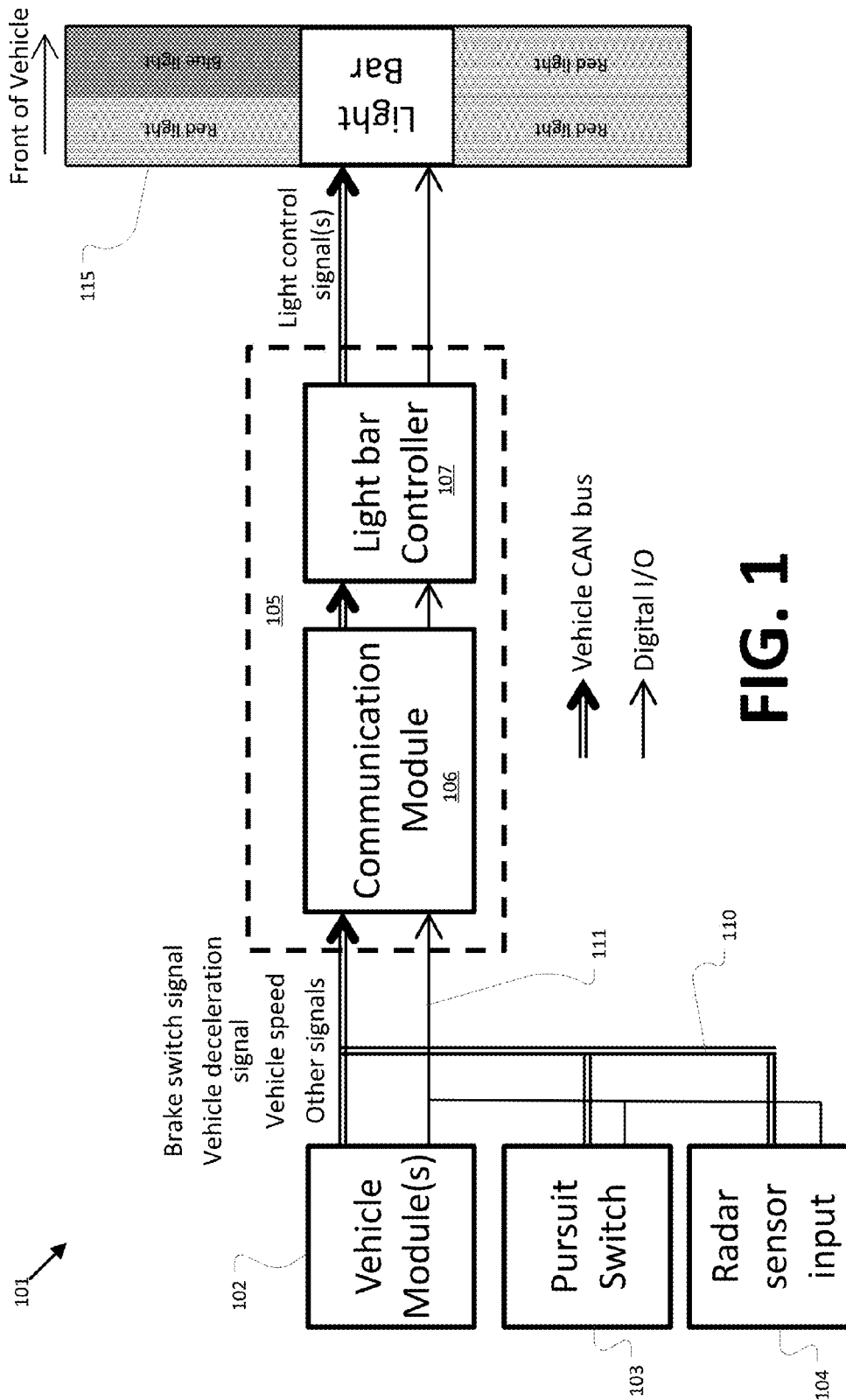


FIG. 1

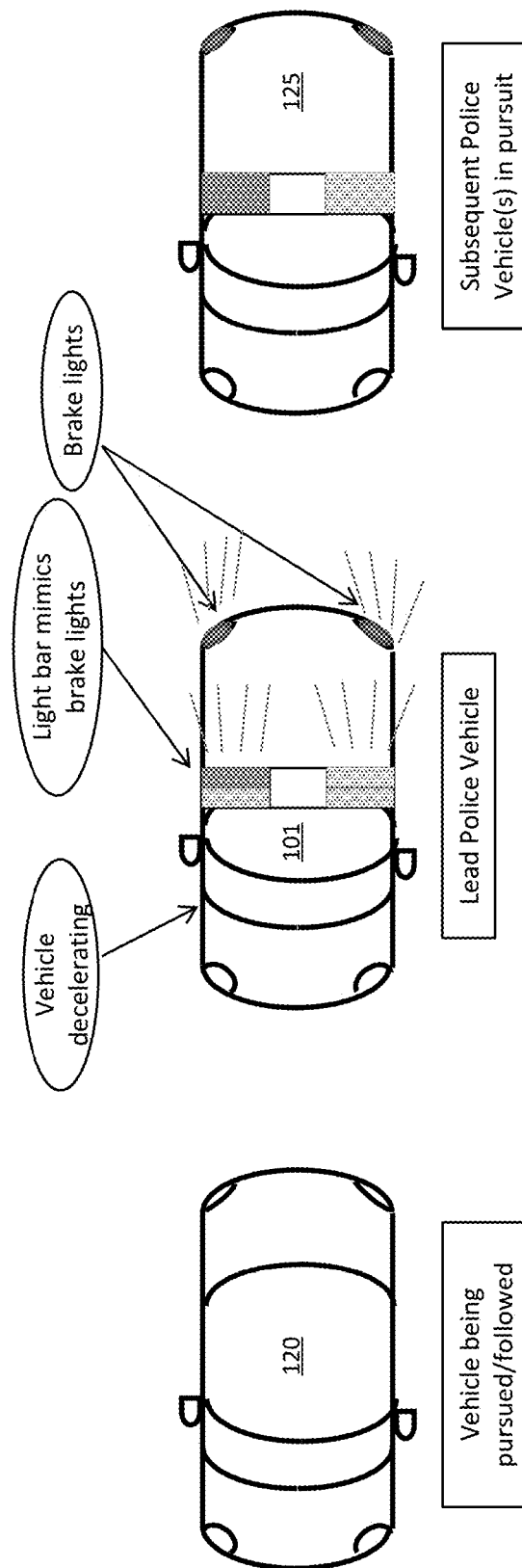


FIG. 2

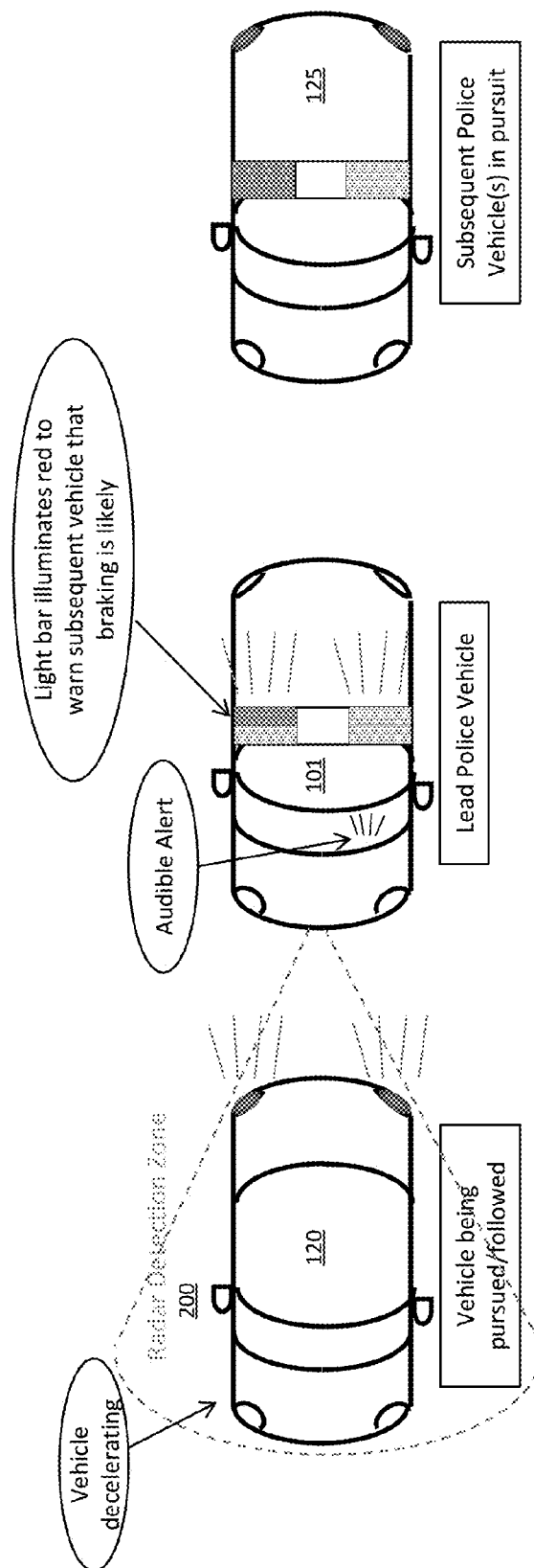


FIG. 3

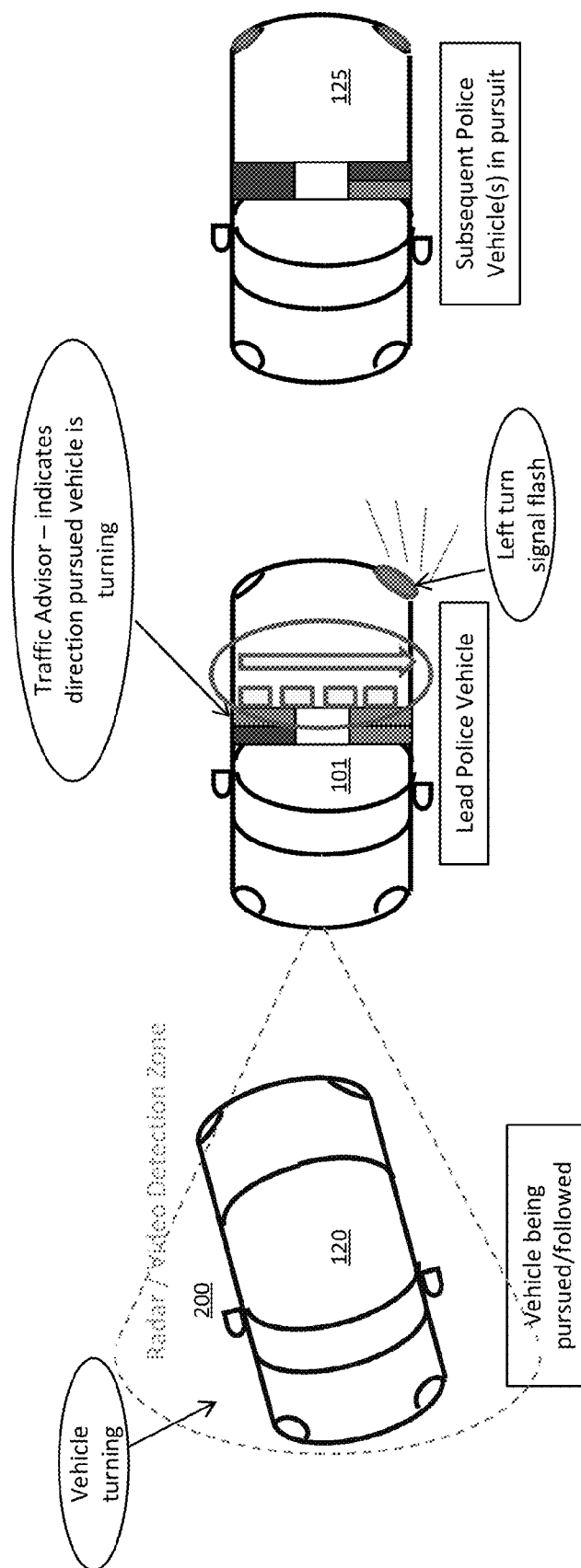
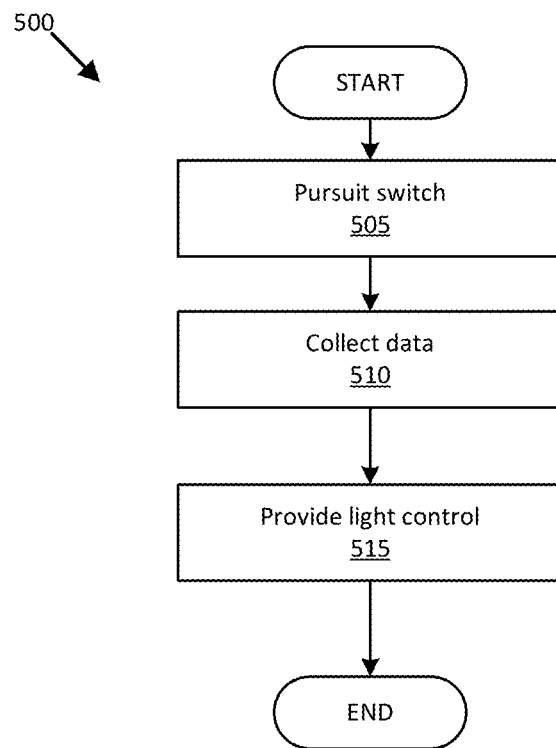


FIG. 4

**FIG. 5**

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EMERGENCY VEHICLE MANEUVER COMMUNICATIONS

RELATED APPLICATIONS

This application claims priority to Provisional Application Ser. No. 61/969,126 filed Mar. 22, 2014 entitled “Emergency Vehicle Maneuver Notification”; Provisional Application Ser. No. 61/969,122 filed Mar. 22, 2014 entitled “Tracking a Suspect From a Vehicle”; Provisional Application Ser. No. 61/969,123 filed Mar. 22, 2014 entitled “Approach Warning for a Police Vehicle”; and Provisional Application Ser. No. 61/969,124 filed Mar. 22, 2014 entitled “Approach Warning for a Police Vehicle”, each of which provisional applications are hereby incorporated herein by reference in their respective entireties.

BACKGROUND

In events such as police pursuit and emergency response situations when emergency lighting is activated in an emergency vehicle such as a police car, ambulance, fire truck, etc., roof and rear window mounted light-bars or the like project emergency vehicle lighting directed rearward. Where multiple emergency vehicles are travelling, e.g., one behind the other, in an emergency situation, drivers of following vehicles supporting the pursuit or emergency response often experience bright lighting from a lead vehicle and/or other vehicles in front of the following vehicle, such bright lighting generally being experienced at a time when aggressive and/or difficult driving maneuvers are required. The effect of bright flashing lights in a lead vehicle or vehicles can cause a delay and or failure in driving response(s) of a driver exposed to such lighting.

DRAWINGS

FIG. 1 is a block diagram of an exemplary vehicle equipped suspect tracking.

FIG. 2 is a block diagram of an example of a first emergency vehicle, followed by a second emergency vehicle, in pursuit of a suspect vehicle.

FIG. 3 is another block diagram of an example of a first emergency vehicle, followed by a second emergency vehicle, in pursuit of a suspect vehicle.

FIG. 4 is yet another block diagram of an example of a first emergency vehicle, followed by a second emergency vehicle, in pursuit of a suspect vehicle.

FIG. 5 is a diagram of an exemplary process for emergency vehicle lighting control.

DETAILED DESCRIPTION

System Overview

FIG. 2 is a block diagram of a first emergency vehicle **101**, followed by a second emergency vehicle **125**, in pursuit of a suspect vehicle **120**. As described herein, and with reference now to FIG. 1, the first, lead, emergency vehicle **101** includes an emergency lighting controller **105** configured to control emergency lights **115** in the vehicle **101**, e.g., to command specific light and/or sound patterns and/or low frequency sounds providing an indication to one or more following vehicles **125** of behavior of a lead vehicle **101** in responding to a pursuit, of a response to a call for support and/or any other need for aggressive driving maneuvers to other nearby vehicles. For example, a pursuit switch **103** in the vehicle **101** may be activated, whereupon lighting **115**

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directed to the rear of the lead vehicle **101** may be reduced and/or a pattern of flashing controlled so as to reduce interference with reactions of following drivers and/or to better signal actions of the lead vehicle **101** to following drivers of vehicles **125**. In general, disclosed herein are systems and methods for integrating law enforcement/emergency vehicle equipment such as the emergency lighting controller **105** and a pursuit switch **103** with standard vehicle elements such as modules **102** and the radar sensor input **104**.

As illustrated in FIG. 1, a vehicle **101** CAN (controller area network) bus **110** or the like, and/or discrete, i.e., digital, data communications **111** provide information to an emergency lighting controller **105** that may include a communication module **106** and a light bar controller **107**. Modules that may provide data to the CAN bus **110** and/or via digital communications **111** include a pursuit switch **103**, a radar sensor input **104**, and/or other vehicle **101** modules **102**. Vehicle **101** sensor **104** output, CAN bus **110** messages, and/or any vehicle outputs **111** indicating status of items such as, but not limited to, vehicle **101** speed, brake status, steering angle, etc., will be used directly by the emergency lighting controller **105** and/or through a “gateway” type interface provided by the communication module **106** between the vehicle **101** systems and the controller **105**, including the light bar controller **107**. Accordingly, vehicle **101** equipment such as the light bar **115** may be controlled based upon operating conditions defined by vehicle **101** CAN bus **110** communications and/or digital messages **111**, thereby to improve notification to nearby vehicles **125** of impending or occurring emergency vehicle maneuvers.

In general, the emergency lighting controller **105** may temporarily disable and/or alter emergency flashing lights, or patterns of the same, in selected directions, and may provide notification, e.g., to following vehicle(s), of certain maneuvers intended and/or taken by a leading vehicle **101** during aggressive driving conditions, e.g., during a pursuit. Further, the lighting controller **105** may provide additional indication(s) of vehicle **101** driving maneuvers during non-aggressive driving conditions such as, but not limited to, using a rear portion of the emergency lighting **115** on rear facing light(s) to duplicate and/or be redundant of the function of vehicle **101** brake lights, and/or using the “traffic advisor” or similar type function that could duplicate and/or be redundant of the function of vehicle **101** turn indicators. As seen in the Figures, the lights **115** can be illuminated according to one or more colors to provide warning and/or messages to a vehicle **101** surroundings.

In addition, vehicle **101** radar system(s) **104** could sense a direction and/or change thereof of the vehicle **120** being pursued and could provide a message/signal to the emergency lighting controller **105** to temporarily disable the rear facing flashing emergency lighting **115** of the vehicle **101**, and/or initiate a light pattern indicating direction of the turn for subsequent vehicles **125** in the pursuit. After the turn maneuver, this turn indication feature could be disabled and original emergency lighting flash patterns could resume. As mentioned above, audible and/or low frequency indications of lead vehicle **101** behavior could also be provided.

As stated above, a vehicle **101** includes an emergency lighting controller **105**, e.g., that might be included in or communicatively coupled to a computing device in the vehicle **101**. The vehicle **101** is generally a land-based vehicle having three or more wheels, e.g., a passenger car, light truck, heavy duty truck such as a fire truck, etc. A computer such as may include the lighting controller **105** generally includes a processor and a memory, the memory

including one or more forms of computer-readable media, and storing instructions executable by the processor for performing various operations, including as disclosed herein. Further, such computer may include and/or be communicatively coupled to more than one computing device, e.g., controllers or the like included in the vehicle **101** for monitoring and/or controlling various vehicle components, e.g., an engine control unit, transmission control unit, etc. The computer **105** is generally configured for communications on a controller area network (CAN) bus **110** or the like. The computer **105** may also have a connection to an onboard diagnostics connector (OBD-II), and or other digital communications mechanisms **111**.

Via the CAN bus **110**, OBD-II, and/or other wired or wireless mechanisms, the computer **105** may transmit messages, e.g., by controlling a color, flash pattern, etc., of one or more lights in the emergency lights **115**, to various devices in a vehicle and/or receive messages from the various devices, e.g., controllers, actuators, sensors, etc., including, without limitation, modules **102**, the pursuit switch **103**, and/or radar sensor input **104**. Alternatively or additionally, in cases where a computer actually comprises multiple devices, including the emergency lighting controller **105**, the CAN bus or the like may be used for communications between such devices. In addition, a vehicle computer may be configured for communicating with other devices via various wired and/or wireless networking technologies, e.g., cellular, Bluetooth, a universal serial bus (USB), wired and/or wireless packet networks, etc.

FIG. 2 illustrates an example in which a message on the vehicle **101** CAN bus **110** or signal **111** indicating vehicle braking is applied, and/or applied at a predetermined specific brake pressure level, could be read by the gateway communications module **106** and provided to the vehicle **101** light bar controller **107** and/or read directly by the controller **107** to command the rear facing light(s) in the light bar **115** to duplicate the function of the vehicle **101** brake lights, e.g., at an output/power level equal to emergency response or reduced power/brightness level. Audible and/or low frequency indications can also be provided, as stated above.

With reference to FIG. 3, a front facing radar **104** or other mechanism, e.g., a front facing camera or lidar sensor, may be used to detect a deceleration of a vehicle **120** being pursued, e.g., the vehicle **101** may detect a deceleration rate equal to or greater than a predetermined threshold of the vehicle **120** being pursued, and may provide a signal **111** or CAN bus **110** message read by the gateway/interface module **106** and made available to the light-bar controller **107** and/or read directly by the light-bar controller **107**, which may then command rear facing lights of the light-bar **115**, rear window mounted lighting, or any other rear-facing emergency lights, e.g., with respect to a light pattern and/or brightness and/or other output that provides an indication of vehicle **101** braking in addition to vehicle **101** brake lights to improve an ability of pursuing/following drivers of vehicles **125** to respond to maneuvers of the vehicle **101**, e.g., during aggressive driving maneuvers. A light pattern could be displayed without the lead vehicle **101** brakes being applied. Audible and/or low frequency indications can also be included, as stated above.

With reference to FIG. 4, a front facing radar **104** or other mechanism, e.g., a front facing camera or lidar sensor that may be included in modules **102** may be used to detect a lateral movement of a vehicle **120** being pursued, e.g., may detect a direction of a turn (left or right) of a vehicle **120** in front and accordingly the emergency lighting controller **105**

may command the rear facing lights of the light-bar **115**, rear window mounted lighting, and/or “traffic advisor” type of bar, to illuminate a flash pattern indicating the direction of the turn to following vehicles to improve an ability of following vehicles **125** to respond, e.g., during aggressive driving maneuvers.

Modules **102** in a vehicle **101** may receive data from a variety of devices, e.g., sensors such as one or more ultrasonic sensors, cameras, lidar sensors, radar sensors, infrared sensors, etc. Further, the foregoing examples are not intended to be limiting; other data could also be provided to a vehicle computer, including the emergency lighting controller **105** and/or other vehicle **101** controllers, from modules **102** such as steering, brake, transmission, engine, etc., controllers, e.g., to provide data via the CAN bus **110** relating to vehicle **101** speed, acceleration, etc. Further, sensors or the like, global positioning system (GPS) equipment, etc., could be included in a vehicle **101** and configured to provide data directly to vehicle **101** computing devices, e.g., via a wired or wireless connection.

Vehicle **101** computing devices include a memory that generally stores data collected as described above. Such data may include a variety of data collected in a vehicle **101**. Examples may include measurements relating to a position, velocity, and size (e.g., length, width, height, radar cross section) of target(s) such as a vehicle **125** in or near a detection zone **200**. Data **115** may additionally include data calculated therefrom in a computer such as the controller **105** and/or other vehicle **101** computer.

The vehicle **101** generally includes a human machine interface. In general, the HMI is equipped to accept inputs for, and/or provide outputs from, one or more vehicle **101** computers, e.g., the controller **105**. For example, the vehicle **101** may include one or more of a display configured to provide a graphical user interface (GUI) or the like, an interactive voice response (IVR) system, one or more audio output devices, etc.

FIG. 5 is a diagram of an exemplary process **500** for emergency vehicle **101** lighting control. The process **500** begins in a block **505**, in which a pursuit switch **103** in a vehicle **101** is selected. As noted above, selection of the pursuit switch **103** may indicate that the vehicle **101** is in pursuit of a vehicle **120**. Generally, selection of the pursuit switch **103** initiates operations of the emergency lighting controller **105** such as described above. Further, additional input may be required to initiate such operations of the emergency lighting controller **105**, e.g., input from a vehicle **101** driver or occupant that following emergency vehicles **125** are present, detection of following emergency vehicles **105** via vehicle-to-vehicle communications, sensor data as described above, or some other mechanism.

Next, in a block **510**, the controller **105** collects data concerning vehicle **101** and/or vehicle **120** operations, e.g., as described above, a vehicle **120** could be detected accelerating, decelerating, turning, etc., as could a vehicle **101**.

Next, in a block **515**, the emergency lighting controller **105** provides control of vehicle **101** lights, e.g., in a light-bar **115**, rear window lights, and/or other lights provided for emergency operation, based on data collected as described above with respect to the block **510**. Further, audible output may be additionally or alternatively provided as described above.

The process **500** ends following the block **515**, e.g., based on input received via the switch **103** or some other mechanism, when a vehicle **101** is stopped or powered off, etc.

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CONCLUSION

In addition or as an alternative to exemplary operations described above, Appendix A attached hereto may further describe such operations and/or relevant subject matter.

The term “police” as used herein may refer to various public and/or private law enforcement and/or security operations, in addition to referring to a formal police department.

Computing devices such as those discussed herein, e.g., the controller 105, generally each include instructions executable by one or more computing devices such as those identified above, and for carrying out blocks or steps of processes described above. For example, process blocks discussed above may be embodied as computer-executable instructions.

Computer-executable instructions may be compiled or interpreted from computer programs created using a variety of programming languages and/or technologies, including, without limitation, and either alone or in combination, Java™, C, C++, Visual Basic, Java Script, Perl, HTML, etc. In general, a processor (e.g., a microprocessor) receives instructions, e.g., from a memory, a computer-readable medium, etc., and executes these instructions, thereby performing one or more processes, including one or more of the processes described herein. Such instructions and other data may be stored and transmitted using a variety of computer-readable media. A file in a computing device is generally a collection of data stored on a computer readable medium, such as a storage medium, a random access memory, etc.

A computer-readable medium includes any medium that participates in providing data (e.g., instructions), which may be read by a computer. Such a medium may take many forms, including, but not limited to, non-volatile media, volatile media, etc. Non-volatile media include, for example, optical or magnetic disks and other persistent memory. Volatile media include dynamic random access memory (DRAM), which typically constitutes a main memory. Common forms of computer-readable media include, for example, a floppy disk, a flexible disk, hard disk, magnetic tape, any other magnetic medium, a CD-ROM, DVD, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, a RAM, a PROM, an EPROM, a FLASH-EEPROM, any other memory chip or cartridge, or any other medium from which a computer can read.

In the drawings, the same reference numbers indicate the same elements. Further, some or all of these elements could be changed. With regard to the media, processes, systems, methods, etc. described herein, it should be understood that, although the steps of such processes, etc. have been described as occurring according to a certain ordered sequence, such processes could be practiced with the described steps performed in an order other than the order described herein. It further should be understood that certain steps could be performed simultaneously, that other steps could be added, or that certain steps described herein could be omitted. In other words, the descriptions of processes herein are provided for the purpose of illustrating certain embodiments, and should in no way be construed so as to limit the claimed invention.

Accordingly, it is to be understood that the above description is intended to be illustrative and not restrictive. Many embodiments and applications other than the examples provided would be apparent to those of skill in the art upon reading the above description. The scope of the invention should be determined, not with reference to the above description, but should instead be determined with reference

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to the appended claims, along with the full scope of equivalents to which such claims are entitled. It is anticipated and intended that future developments will occur in the arts discussed herein, and that the disclosed systems and methods will be incorporated into such future embodiments. In sum, it should be understood that the invention is capable of modification and variation and is limited only by the following claims.

All terms used in the claims are intended to be given their broadest reasonable constructions and their ordinary meanings as understood by those skilled in the art unless an explicit indication to the contrary is made herein. In particular, use of the singular articles such as “a,” “the,” “said,” etc. should be read to recite one or more of the indicated elements unless a claim recites an explicit limitation to the contrary.

The invention claimed is:

1. A system for improved vehicle emergency lighting control, comprising a computer deployable in a first vehicle, the computer comprising a processor and a memory, wherein the computer is programmed to:

collect data related to a pursuit of a second vehicle;
use the collected data to identify a turn of at least one of the first vehicle and the second vehicle; and
control an emergency light in the first vehicle based on the at least one determined turn.

2. The system of claim 1, wherein the collected data includes at least one of a position, speed, acceleration, deceleration, and turning of the first vehicle.

3. The system of claim 1, wherein the collected data includes at least one of a position, speed, acceleration, deceleration, and turning of the second vehicle.

4. The system of claim 1, wherein the collected data includes at least one of ultrasonic, image, radar, lidar, global positioning system (GPS), and infrared data.

5. The system of claim 1, wherein the collected data includes data from at least one of a steering controller, a brake controller, an engine controller, and a transmission controller.

6. The system of claim 1, wherein the emergency light in the first vehicle faces a rear portion of the first vehicle.

7. The system of claim 1, wherein the computer is further programmed to detect activation of a pursuit switch before executing the control of the emergency light in the first vehicle based on the at least one determined action.

8. The system of claim 1, wherein the control of the emergency light in the first vehicle is provided according to a communication sent via a controller area network (CAN) bus in the first vehicle.

9. The system of claim 1, wherein the control of the emergency light in the first vehicle is provided according to a communication sent via a discrete communication.

10. The system of claim 1, wherein the computer is further programmed to provide an audible indication of the determined action.

11. A method for improved vehicle emergency lighting control, comprising, in a computer in a first vehicle:

collecting data related to a pursuit of a second vehicle;
using the collected data to identify a turn of at least one of the first vehicle and the second vehicle; and
controlling an emergency light in the first vehicle based on the at least one determined action.

12. The method of claim 11, wherein the collected data includes at least one of a position, speed, acceleration, deceleration, and turning of the first vehicle.

13. The method of claim **11**, wherein the collected data includes at least one of a position, speed, acceleration, deceleration, and turning of the second vehicle.

14. The method of claim **11**, wherein the collected data includes at least one of ultrasonic, image, radar, lidar, global positioning system (GPS), and infrared data. 5

15. The method of claim **11**, wherein the collected data includes data from at least one of a steering controller, a brake controller, an engine controller, and a transmission controller. 10

16. The method of claim **11**, wherein the emergency light in the first vehicle faces a rear portion of the first vehicle.

17. The method of claim **11**, further comprising detecting activation of a pursuit switch before executing the control of the emergency light in the first vehicle based on the at least one determined action. 15

18. The method of claim **11**, wherein the control of the emergency light in the first vehicle is provided according to a communication sent via a controller area network (CAN) bus in the first vehicle. 20

19. The method of claim **11**, wherein the control of the emergency light in the first vehicle is provided according to a communication sent via a discrete communication.

20. The method of claim **11**, further comprising providing an audible indication of the determined action. 25

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